Electromyography

General information

There are 3 phases of an EMG exam:

▶ Phase 1 - insertional activity. The electric response of the muscle to mechanical irritation caused by small movements of the needle.

▶ Phase 2 - spontaneous activity. In muscle at rest.

1. normal: silent with stationary needle once insertional activity has subsided

2. spontaneous activity: independently produced electrical activity. Usually abnormal (although sometimes seen in normal volunteers).

a) after denervation (secondary to a nerve injury) or muscle injury:

● positive sharp waves (PSW)

● fibrillation potentials (AKA fibrillations or fibs): action potentials arising from single muscle fibers. Detectable on EMG; not visible to the naked eye, c.f. fasciculations. Earliest onset 7–10 days after denervation, sometimes not for 3–4 weeks. If the nerve recovers, it may reinnervate the muscle, but with larger motor units resulting in longer duration and decreased numbers

b) myotonic discharges (“dive bomber” sound on speaker monitor)

c) complex repetitive discharge (CRD): ephaptic conduction of groups of adjacent muscle fibers. Occurs in neuropathic or myopathic disorders

d) fasciculation potentials: nonspecific, but typically associated with motor neuron disease (ALS)

e) other less common spontaneous activity includes: myokymic, neuromytonic and cramp discharges

▶ Phase 3 - volitional activity. Evaluated with minimal volitional effort and maximal effort. 1. motor unit action potential (MUAP) analysis: includes evaluation of motor unit amplitude, duration, polyphasia and stability. Generally increased amplitude and duration suggest a disorder of the lower motor neuron (LMN), and reduced amplitude and duration suggest a primary myopathy

2. with minimal volitional effort. Two possible abnormal findings

a) reduced recruitment (or fast firing) is always indicative of a neuropathic process

b) early or increased recruitment: indicative of a myopathic process

3. with maximal effort

Electromyography (EMG) is a technique for evaluating and recording the electrical activity produced

by skeletal muscles.

Lumbar Electromyography

Lumbar Electromyography

EMG monitors somatic efferent nerve activity and evaluates the functional integrity of individual nerves. EMG monitors intracranial, spinal, and peripheral nerves during surgeries. Depolarization of a motor nerve produces electrical potential within the muscles innervated by that specific nerve, and the generated electrical activity is monitored using subdermal or intramuscular electrodes [1)].

EMG is performed using an instrument called an electromyograph, to produce a record called an electromyogram. An electromyograph detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, or recruitment order or to analyze the biomechanics of human or animal movement.

Nardin et al compared electromyography (EMG) and MRI in a mixed group of cervical and lumbar radiculopathies, although the majority were cervical. EMG was significantly abnormal at the clinically suspect or the adjacent level and side in 72% of clinically definite, 40% of clinically probable and 29% of clinically possible cases of radiculopathy. Surprisingly, the proportion of abnormal MRI findings was similar in each group, and abnormality was just as likely on the asymptomatic side as the symptomatic side. This casts doubt on the specificity of MRI. In an editorial in the same journal, Robinson reworked the data, and noted a very low correlation between symptoms and MRI abnormalities. Many of these issues have been reviewed recently.

The patients in this study are highly selected on the basis that first-line imaging (i.e. standard cervical spine MRI) had not provided a clear answer or explanation for their symptoms and signs, and these were felt sufficiently troublesome to warrant further investigation. A high proportion had had previous cervical spine surgery, and several had associated myelomalacia and focal cord atrophy. The atypical nature of this group may explain, at least in part, the poor correlation between the clinical picture and the findings on standard MRI.

1)

Singh H, Vogel RW, Lober RM, Doan AT, Matsumoto CI, Kenning TJ, Evans JJ. Intraoperative Neurophysiological Monitoring for Endoscopic Endonasal Approaches to the Skull Base: A Technical Guide. Scientifica (Cairo). 2016;2016:1751245. doi: 10.1155/2016/1751245. Epub 2016 May 16. PMID: 27293965; PMCID: PMC4886091.